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The Biology of Seven Troidine Swallowtail Butterflies (Papilionidae) in Colima, Mexico

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Abstract. Observations on the early stages and ecology of the following aristolochia-feeding swallowtail butterflies are presented: *Battus philenor philenor* (Linnaeus), *B. polydamas lucayus* (Rothschild and Jordan), *B. eracon* (Godman and Salvin), *B. laodamas procas* (Godman and Salvin), *Parides photinus* (Doubleday), *P. montezuma* (Westwood), and *P. erithalion trichopus* (Rothschild and Jordan). Observations were made during 1979–1982 in the state of Colima, Mexico, by Paul Spade.

Resumen. Se presenta información sobre los estadios inmaduros y la ecología de los siguientes papiliónidos que comen aristolocáreas: *Battus philenor philenor* (Linnaeus), *B. polydamas lucayus* (Rothschild and Jordan), *B. eracon* (Godman and Salvin), *B. laodamas procas* (Godman and Salvin), *Parides photinus* (Doubleday), *P. montezuma* (Westwood), y *P. erithalion trichopus* (Rothschild and Jordan). Los datos fueron obtenidos durante 1979–1982 en el estado de Colima, México.

Introduction

Four species of *Battus* Scopoli are known from the state of Colima, Mexico: *B. philenor philenor* (Linnaeus), *B. polydamas lucayus* (Rothschild and Jordan), *B. eracon* (Godman and Salvin), and *B. laodamas procas* (Godman and Salvin). In the same region three species of *Parides* Hübner have been documented: *P. photinus* (Doubleday), *P. montezuma* (Westwood), and *P. erithalion trichopus* (Rothschild and Jordan). Both genera are confined to the New World, predominantly South America. *Battus* is the smaller, containing 14 species; *Parides* encompasses between about 32 and 45 species, 9 of which occur in Mexico.

Battus and *Parides* are members of the tribe Troidini (Papilionidae), commonly referred to as aristolochia swallowtails (Rothschild and

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Jordan 1906; Munroe 1960; Ehrlich and Raven 1965) because their larvae feed exclusively on members of the genus *Aristolochia* Linnaeus (Aristolochiaceae). This plant genus, composed primarily of tropical vines, can be divided into two natural groups in the Americas: pentandrous and hexandrous species (5 and 6 stamens respectively) (Pfeifer 1966, 1970). Table 1 outlines the major characteristics and distributions of *Aristolochia* species utilized by *Battus* and *Parides* in Colima.

Aristolochia species contain a number of secondary plant compounds including aristolochic acids, benzylisoquinoline alkaloids, and sesquiterpenoids, which in general deter both insect and vertebrate phytophagy (Fraenkel 1959). Some members of the Troidini are known to sequester these substances from their foodplants, rendering the butterflies distasteful to vertebrate predators. Consequently their colors are aposematically adapted (Brown, Damman and Feeny 1981). Hence adults are models in Batesian mimetic complexes involving butterflies of the same family in the genus *Papilio* Linnaeus (Brower 1958) and *Eurytides* Hübner. Various *Battus* and *Parides* species form Müllerian mimicry complexes as well (Young 1971a, 1971b, 1972; Brown, Damman and Feeny 1981).

The purpose of this paper is to present brief descriptions and illustrations of the early stages, summarize data on host utilization and geographic distribution, and identify the major mimetic complexes among the seven troidine swallowtails that occur in Colima, Mexico.

Methods and Study Area

The field work, including photography, was carried out by Paul Spade from November 1979 to November 1982. Specimens of both butterfly and *Aristolochia* species were sent by Spade to Hamilton Tyler who arranged for their determination. Voucher specimens of the butterflies were deposited in the San Diego Natural History Museum; no larvae were preserved. With the assistance of Michael Parsons, a preliminary draft of the present manuscript was completed. After the untimely death of Tyler, John Brown was responsible for the final organization and presentation of the paper.

Field work was conducted at 23 sites in Colima and 3 sites in the neighboring states of Michoacan and Jalisco (figure 1). Only the Colima localities mentioned in the text are shown in figure 1. All records of oviposition and hostplant selection are based on the discovery of eggs and larvae, or the observation of ovipositing females, in the field. Once located, the early stages were brought into the lab (Spade residence in Colima) and reared on the field-associated host at ambient temperature. All photographs were taken in the lab. No measurements of the early stages were noted as they were nearly identical, and most have been presented previously elsewhere (see literature citations in *Observations*).

Fig. 1. Map of Colima, Mexico.

Colima is located along the western coast of mainland Mexico. Although one of the smallest states in the Republic, it is topographically extremely diverse; elevation ranges from sea level to nearly 3900 m at the peak of the Fuego Volcano. The Pacific shoreline, approximately 160 km long, is bordered by a narrow coastal plain. Low coastal ranges rise abruptly from the plain and quickly attain an elevation of 700–1300 m. Colima, the capital city, is located in the east-central part of the state on a dissected plateau which varies in altitude from 300–600 m. The interior mountain ranges rise to a nearly uniform elevation of about 2000 m.

According to Schaldach (1963), eight distinct vegetational zones occur within Colima, six of which are relevant to this study. These can be summarized as follows:

(1) **Arid thorn scrub**. A low, semi-open scrub community composed of spiny deciduous shrubs and legumes occurring along the coastal plain and the basal slopes of the coastal mountains.

(2) **Arid thorn forest**. A relatively tall (10–12 m), homogeneous forest of flowering trees, mostly legumes, found on hillsides and in many of the interior valleys. These deciduous forests are often dense with a thick undergrowth of thorny vines.

(3) **Riparian gallery forest**. Heavily shaded forests of tall, mainly evergreen trees, bordering all the permanant watercourses of the lower tropical area.

(4) **Tropical deciduous forest**. Tall, climax deciduous forest composed of many species of tropical trees; generally found above arid thorn

forest at higher, moister habitats, but may occur in lower elevations in response to local precipitation.

(5) **Oak woodland**. Nearly pure stands of low oaks found on the higher ridges of the mountains. Scattered pines occur amid the oaks, but nowhere do they form significant forests.

(6) **Arid pine-oak forest**. Open, dry forests of tall pines interspersed with medium-sized oaks, occurring primarily around the volcanoes from about 1800–2400 m. This is the highest habitat in which troidines occur in Colima.

Observations

Battus philenor philenor (Linnaeus)

Early stages. The early stages of *B. philenor* in Colima closely resemble those from elsewhere. First described by Edwards (1881), they are summarized in numerous accounts (e.g., Klots 1951; Emmel 1975; Opler and Krizek 1984; etc.); they are not illustrated here. The spherical egg is russet in color. First through third instar larvae are gregarious; later instars feed singly. The ground color of fourth and fifth instar larvae is usually dark purple with contrasting orange-red tubercles. However, a second color form also occurs in which the ground color is the same orange-red as that of the tubercles; the outer two-thirds of the anterior tubercles and the tips of both the longer thoracic and first abdominal tubercles, are tipped with black. This second color morph also occurs in southeastern Arizona populations of *B. philenor* (A. Shapiro, personal communication).

The pupae are dimorphic, as noted by West and Hazel (1979). One clutch of *B. philenor* yielded 15 brown, 3 green, and one mixed (brown and green) pupae. Thoracic projections of the pupae of *B. philenor* from Colima are less prominent than those from elsewhere.

Oviposition and foodplants. Eggs are laid in small batches of 4–6 on the undersides of the leaves of the foodplant, forming a well spaced group (as opposed to a close cluster). At Madrid, Colima, the preferred foodplant was *Aristolochia acontophylla*, on which larvae of *Parides montezuma* also were found. Where *A. acontophylla* was unavailable, the butterfly rarely utilized *A. tentaculata*. At higher altitudes, larvae occurred on *A. pringlei*. Many other species of *Aristolochia* are used by *B. philenor* in other parts of its wide geographic range; these are summarized by Scriber and Feeny (1976). Rausher (1980, 1981) provides data on host plant selection and temporal changes in oviposition preference.

Habitat and range. In the Colima region, *B. philenor* occupies relatively dry habitats receiving an annual precipitation of less than 1200 mm and characterized by a long dry season. *B. philenor* occurs from sea level to about 2400 m, reaching its upper limit in the arid pine-oak forests. In

western Michoacan, *B. philenor* was present on the coast at Placita and Aquila, but just inland, in the northern region near Zapotan, no adults were observed during a six-month period from June to November 1982. The species was common in regions of arid thorn scrub and arid pine-oak forest, but it was conspicuously absent from the humid forest above Colima (city).

Battus polydamas lucayus (Rothschild and Jordan) (figures 2, 8, and 14)

Early stages. The life history of this species has been recorded by Moss (1919), Comstock and Vazquez (1960), Young (1971a), and Brown, Damman, and Feeny (1981). Eggs (fig. 2) are pale brown bearing 10–12 orange-brown vertical ribs of a glue-like colleterial substance that adheres them to the leaf of the foodplant.

The first instar larva is pale straw yellow; the short, hirsute tubercles bear long black setae. The second instar is brown-black, sparsely marked with tan-brown; the tubercles are light brown except those of abdominal segments 3 and 7, which are orange. The third instar is tan-gray with contrasting transverse, oblique, brown lines on each segment. The tubercles have a light brown base and darken towards the apex; the lateral tubercles are twice the length of the dorsal ones. The fourth instar larva is gray with thin, black transverse lines. All of the tubercles are cream-white with black tips, except the lateral tubercles, which are black with a cream base. The fifth instar is dimorphic. The pale form (fig. 8) is yellow-brown and resembles the fourth instar, while the other form is dark brown with black transverse lines, and black-tipped pink tubercles. The base of the lateral prothoracic tubercles is pale pink in the dark form, creamy yellow in the light form.

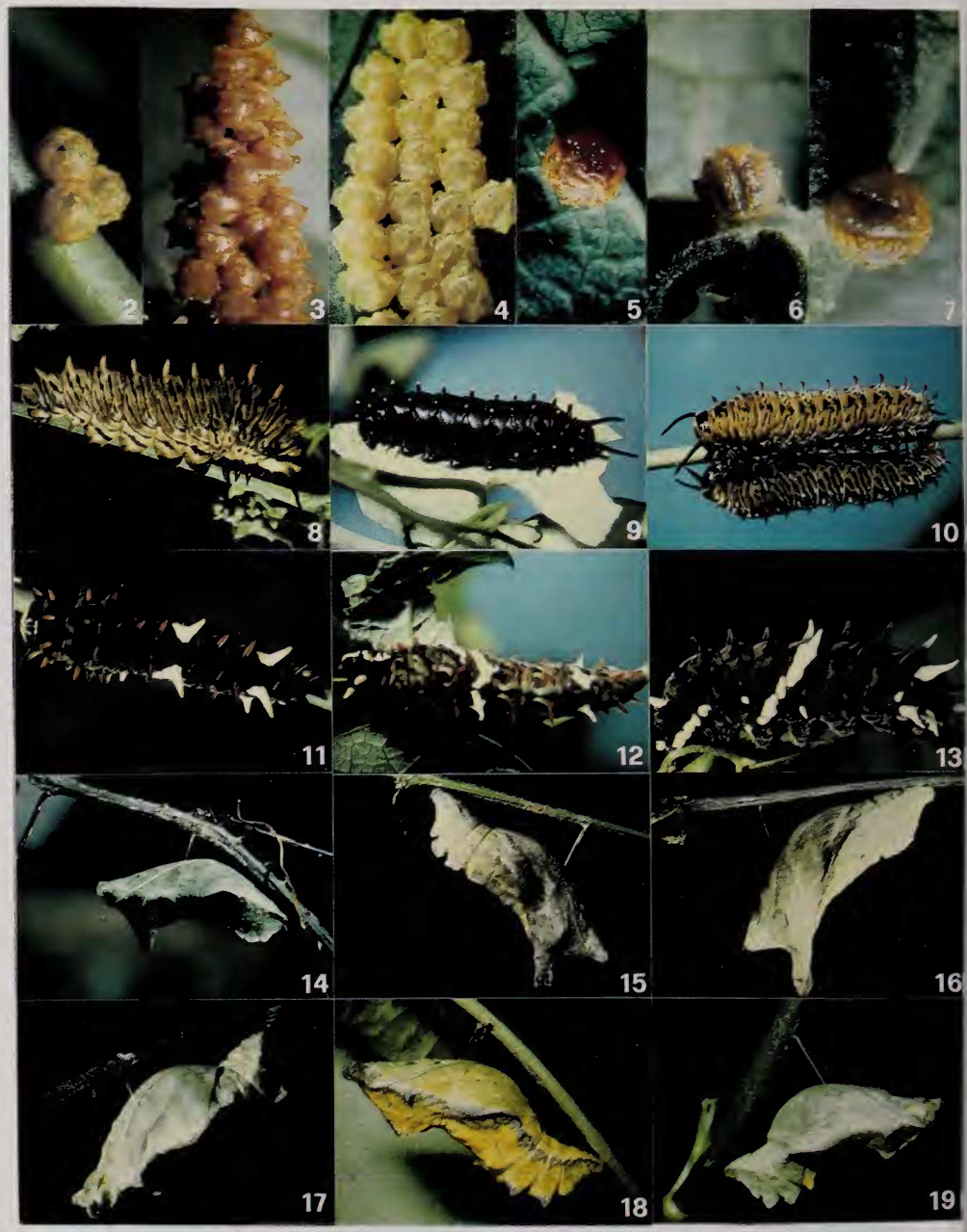
The pupae are dimorphic: one form (fig. 14) is green with pale yellow saddle and antennae, the other form brown. The pupa has a prominent, conical, dorsal thoracic projection, and the abdomen bears two prominent dorsolateral ridges.

Oviposition and foodplants. Females typically lay eggs in small clusters of 2–9 in a band around the stem of the host. In Colima, larvae were found on *Aristolochia acontophylla, A. foetida, A. odoratissima, A. tentaculata*, and *A. conversiae.*

Habitat and range. B. polydamas is the most common troidine in Colima. Throughout its range in the State it occupies primarily open habitats such as agricultural land, gardens, and arid thorn scrub; but it also occurs in riparian gallery forest. It is common from sea level to about 500 m, ranging as high as 900 m. An exceptionally high elevation record for this species in Colima is 1360 m at Cofradia de Suchitan.

Battus eracon (Godman and Salvin) (figures 3, 9 and 15)

Early stages. There are no details of the life history of this species in the literature. Eggs (fig. 3) are pink with irregular rib-like globules of



Figs. 2–7. Eggs of *Battus polydamas* (2); *B. eracon* (3); *B. laodamas procas* (4); *Parides photinus* (5); *P. montezuma* (6); and *P. erithalion trichopus* (7).

Figs. 8–13. Last instar larvae of *Battus polydamas* (8); *B. eracon* (9); *B. laodamas procas* (10); *Parides photinus* (11); *P. montezuma* (12); and *P. erithalion trichopus* (13).

Figs. 14–19. Pupae of *Battus polydamas* (14); *B. eracon* (15); *B. laodamas procas* (16); *Parides photinus* (17); *P. montezuma* (18); and *P. erithalion trichopus* (19).

orange glue-like colleterial secretion which binds each egg within the batch and gives them a warty appearance.

Unfortunately, field collected eggs were eaten, presumably by ants, so first and second instar larvae were not obtained. Subsequent field collected larvae were all in later instars. Third instar larvae are chocolate brown with only the tips of the tubercles orange; the lateral prothoracic tubercles are concolorous with the body and much longer than the rest. Of the four species of *Battus* in Colima, *B. eracon* has the shortest tubercles. The fourth instar is indistinguishable in pattern from the third, but its ground color is maroon-brown. Fifth instar larvae are dimorphic: the dark form (fig. 9) is the most common and is almost entirely purple-black; only the tubercles are orange-tipped. The pale form is brown with oblique brown-black markings similar to those of *Battus polydamas*, with the lateral prothoracic tubercles entirely black. In both forms the head and thoracic prolegs are black. The first three instars probably feed gregariously, later instars feed singly.

The pupae are dimorphic: one form is green and yellow, the other (fig. 15) brown with greatly reduced yellow markings. Pupae average 37 mm long and 20 mm wide, with a dorsal thoracic projection of about 5 mm, more club-shaped than that of *B. laodamas procas*.

Oviposition and foodplants. A single female was observed ovipositing. Eggs were irregularly piled in batches of 20–30, near the ground, on the sides of stems supporting the foodplant, *Aristolochia tentaculata*.

Habitat and range. *B. eracon* is the most restricted mainland *Battus*, limited to the coastal regions of Colima, Jalisco, Michoacan, and Guerrero, Mexico (Hoffman 1976; Diaz Frances and de la Maza 1978). It is common between sea level and 200 m, where its range includes the coastal hills at Caleras. In Colima, *B. eracon* is locally abundant at Cerro de la Vieja (near Coquimatlan) and Tepames; both localities are about 500 m in elevation. It has not been observed above 610 m. In Michoacan, *B. eracon* occurs at Placita, Aquila, San Telmo, and Zapotan. Its principal habitats are riparian gallery forest, arid thorn forest, and tropical deciduous forest; adults are avidly attracted to nectar sources within these habitats. It is scarce in urban and arid thorn scrub areas.

Battus laodamas procas (Godman and Salvin) (figures 4, 10, 16)

Early stages. Comstock and Vazquez (1960) described the final instar and pupa of this species. Eggs (fig. 4) are pale yellow with six irregular vertical, rib-like strands of glue-like colleterial substance of the same color.

First instar larvae are light brown with black-tipped tubercles bearing long setae; the head is shiny black. Second, third, and fourth instar larvae are entirely black. Two distinct forms and intermediates are exhibited by fifth instar larvae: one form is entirely black, the other (fig. 10) is light brown with oblique black markings similar to those of *B.*

polydamas. In the brown form the tubercles are black-tipped. All instars feed gregariously.

The pupae are dimorphic with a green and yellow form, and a gray-brown form (fig. 16) that has greatly reduced yellow markings. The abdominal tubercles are reduced, forming two dorsolateral ridges.

Oviposition and foodplants. Eggs are laid in parallel rows in batches of 20–30 on the upper surface of leaves of *Aristolochia tentaculata*. Oviposition is generally between 3–4 m above the ground and always above 2 m.

Habitat and range. *B. laodamas procas* has the same distribution as *B. eracon* along the Pacific coast, but ranges further inland and into higher altitudes. It is most common from sea level to about 500 m. However, in the mountains it has been recorded as high as 1280 m.

Parides photinus (Doubleday) (figures 5, 11, and 17)

Early stages. The life history of *P. photinus* has been described in detail by Ross (1964). The following descriptions are based on observations in Colima. The egg (fig. 5) is dark pink with about 15 irregular, warty, vertical strands of yellow-orange colleterial secretion. Each egg rests on a short pedestal of the same substance, to one side of the base.

First instar larvae are gray with the dorsal tubercles of abdominal segments 4 and 7 pale yellow, and the thoracic and anal two pair of dorsal tubercles pale orange. The remaining tubercles are burgundy. Second instar larvae are darker; dorsal tubercles four and seven are creamy white. The thoracic tubercles and those at the anal end of the abdomen are pink. The third instar is dimorphic. The lighter form is similar to the preceding instar, but the dorsal tubercles on abdominal segments 4 and 7 are ivory-white. An oblique white line joins tubercle four with the lateral tubercle on abdominal segment 3 which is also ivory-white. The thoracic tubercles and the two pair of dorsal tubercles on the last abdominal segment are creamy orange, tipped with orange-red. The dark form is similar but the lateral and dorsal tubercles on abdominal segments 4 and 7 are ivory-white with a white stripe joining those on segment 4. All of the remaining tubercles and the ground color are dark red. First through third instar larva bear black setae at the tips of the tubercles. The fourth instar is also dimorphic, the two forms similar to those of the third instar The fifth instar is dimorphic: one form (fig. 11) is black with white and red tubercles which have an orange cast; the other is purple-black with dark red tubercles.

The pupa (fig. 17) is pale yellow dorsally and pale green ventrally. It has two short, triangular, dorsolateral processes on the thorax, and the abdomen bears a row of three pairs of triangular-shaped dorsolateral projections.

In Colima, the duration of the early stages is fairly rapid: egg, 6 days; first and second instar, 3 days; third instar, 3 days; fourth instar, 2 days;

fifth instar 3 days, prepupa to eclosure, 18–20 days. In *Battus* and *Parides* species studied by Brown, Damman, and Feeny (1981), larvae developed in 20–30 days. They suggest that in addition to temperature, developmental rates dependent greatly upon the species of *Aristolochia* utilized.

Oviposition and foodplants. In low to mid-elevations *Aristolochia tentaculata* is the larval host. At slightly higher elevation *A. conversiae* is utilized. In the vicinity of the Nevada de Colima Volcano, Jalisco, just north of the Fuego Volcano, the host is *A. pringlei.* Eggs are laid singly on the leaves.

Habitat and range. In Colima, *P. photinus* was observed in lower arid thorn forests at about 400 m, in oak woodlands at about 1680 m, and in arid pine-oak forests at 2400 m. It seems to favor forest margins and areas of disturbed or secondary vegetation. *P. photinus* exhibits the greatest altitudinal range of any of the Colima troidines except for *B. philenor.*

Parides montezuma (Westwood) (figures 6, 12, and 18)

Early stages. There are no details of the life history of this species in the literature. The egg (fig. 6) is pale gray-brown with about 12 irregular, warty, vertical rib-like strands of yellow colleterial substance. The egg rests on a pedestal of colleterial substance which is shorter than that of *P. photinus.*

First instar larvae have a pinkish yellow ground color with yellow-orange tubercles that bear long gray setae. The head is tan-brown. The second instar larva is dark gray with the tubercles light orange except for the dorsal ones of the mesothorax and abdominal segments 4 and 7, which are white. The third instar is white with the tubercles red-orange except for the lateral ones on the meso- and metathorax, and on abdominal segments 3 and 7, which are white. There are oblique gray-brown stripes laterally on each segment. The fourth instar is similar in pattern, but the white tubercles are highlighted by a more extensive pattern of darker brown stripes. The remaining tubercles are red. The head and thoracic prolegs are black. In the fifth instar (fig. 12) the ground color is gray-black, with numerous oblique black stripes, the white tubercles strongly contrasting. The remaining tubercles are burgundy. Both the ground color and tubercle color exhibit a narrow but conspicuous range of variability in the fifth instar.

The pupa (fig. 18) is yellow with a lavender-gray lateral abdominal band that continues onto the wings and the lateral tubercles of the mesothorax. The same color forms a midline dorsally along the thorax, continuing onto the frontal tubercles and those of the abdomen as well. The dorsal saddle of the abdomen has a pink midline and two fine dorsolateral lines of gray. Ventrally the wings and legs are greenish yellow.

Oviposition and foodplants. Eggs are always laid singly on the undersides of leaves of the foodplant or on the tips of new vegetative shoots. Ovipositing females are easily followed as they exhibit a slow, fluttering flight close to the ground. Eggs are never deposited higher than 1.5 m above the ground. At Estapilla, in arid thorn scrub, a female was observed ovipositing on an *Aristolochia acontophylla* plant which was only 15 cm tall. The same species of foodplant is utilized at Zapotan and Madrid. In the latter locality *P. montezuma* also was observed ovipositing on *A. foetida*, although no larvae were ever encountered on this species. At Madrid an undescribed species of *Aristolochia* was available, but never utilized by *P. montezuma*. Eggs of *P. montezuma* were found once on *A. cardiantha*. At higher elevations *A. conversiae* is utilized.

Habitat and range. P. montezuma is generally common throughout its range from sea level to about 1360 at Cofradia de Suchitan, occupying a variety of habitats including arid thorn and tropical deciduous forests. Unlike *P. photinus, P. montezuma* does not occur in the arid pine-oak forest.

Parides erithalion trichopus (Rothschild and Jordan) (figures 7, 13, and 19)

Early stages. An outline description of the early stages of this species was presented by de la Maza (1980). The egg (fig. 7) is pale gray with about 12 irregular, warty, vertical rib-like strands of orange glue-like colleterial secretion. Eggs are laid singly on the underside of leaves of the foodplant, and rest on a short pedestal of colleterial substance to one side of the base. The glue-like strands are more granular in appearance than on the eggs of either *P. montezuma* or *P. photinus*, and the pedestal is shorter than in those two species.

The first instar is orange-yellow except for the mesothoracic tubercles and the dorsal tubercles of abdominal segments 4, 7, and 9, which are translucent white. The prothoracic shield is gray-brown and the head is shiny black. The second instar is yellow-gray with the lighter tubercles brighter white. The lateral tubercles of the prothorax, metathorax, and abdominal segments 7 and 9 are also white. The remaining tubercles are translucent orange-yellow. In the third instar the ground color is reddish brown, the darker tubercles pinkish red. The lateral tubercles of abdominal segments 7 and 8 are white. The fourth instar is similar, but the ground color and darker tubercles are burgundy, and the white tubercles on abdominal segments 3 (lateral) and 4 (dorsal) are joined by an oblique white stripe. The tips of the dorsal tubercles on abdominal segment 5 are white. In instars one through four, the tubercles bear setae. These are longest on the first instar and decrease in length at each successive molt. Fifth instar larvae are dimorphic: one form (fig. 13) is gray-black, the other dark brown. Both are marked with oblique

charcoal-black lines. The white of the lighter tubercles is quite extensive and gives the larva a clearly defined anterior, median, and posterior pattern of lines and spots.

The pupa (fig. 19) is greenish gray; the dorsal region, the saddle of the abdomen, and the cremaster are yellow. The dorsolateral tubercles of the abdomen are broad and triangular in profile.

Oviposition and foodplants. Females exhibit a slow, low, fluttering flight while searching for foodplants. Eggs are laid singly on the underside of leaves of the host, or occasionally near the tips of new shoots. At Tamala, La Salada, Madrid, and Caleras, *P. erithalion* utilizes an undescribed, deciduous species of *Aristolochia*. Other hosts documented from the lowlands include *A. tentaculata* and *A. mutabilis*. *Aristolochia conversiae* is assumed to be the host at mid elevations (e.g., San Antonio and Tonila) where it is the only potential foodplant available.

Habitat and range. P. erithalion trichopus is limited to western Mexico. In Colima it has been observed from sea level to 1520 m, but this may not be its upper limit. The species was abundant in arid thorn forest, less common in arid thorn scrub. With the exception of large urban areas, *P. erithalion* was fairly common in all habitats.

Mimetic Associations of Adults

In Jalisco, *Battus philenor* and *Parides alopius* (Godman and Salvin), both assumed to be unpalatable, form a Müllerian mimetic complex. In Colima, *B. philenor* is the model for the palatable *Papilio polyxenes asterius* Stoll, a Batesian mimic over much of their extensive concurrent geographical ranges. *B. polydamas, B. laodamas*, and *B. eracon* are assumed to be unpalatable, and comprise a Müllerian mimetic complex in Colima, in which *B. polydamas* is the most common species. Also associated with these species are the Batesian mimics *Papilio victorinus morelius* Rothschild and Jordan, which is common, and females of *Papilio astyalus* Godart, a population similar to *P. astyalus occidentalis* Brown and Faulkner, which are uncommon. Females of *Papilio androgeus epidaurus* Godman and Salvin also may be Batesian mimics of the *Battus* complex.

The three *Parides* species in Colima form their own Müllerian mimetic complex, again assuming unpalatability. *Papilio pharnaces* (Westwood), *P. anchisiades* Esper, *Eurytides thymbreus aconophus* (Gray), and *E. belesis* (Bates) are Batesian mimics of the *Parides* group, the former representing an extraordinary convergence to *Parides* in both coloration and pattern. The nymphalid butterfly *Biblis hyperia* (Cramer) is also a Batesian mimic of *Parides* in Colima.

Conclusions

Table 2 summarizes the field data of foodplant utilization by Troidini

Table 1. Characteristics and distribution of *Aristolochia* species in Colima, Mexico.

species	hexandrous/ pentandrous	growth habit	size	habitat	elevations in Colima	general distribution
A. tentaculata Schmidt	hexandrous	glabrous small lianas	large; to 7 m	widespread	common to 800 m; sparse 800-900 m; pockets to 1036 m	Colima, Michoacan, Guerrero, D.F.
A. glossa Pfeifer	hexandrous	glabrous lianas	very large	riparian	0-250 m	Colima and Michoacan
A. odoratissima Linnaeus	hexandrous	glabrous lianas	large	riparian	0-250 m	Mexico to Panama
A. n. sp	pentandrous	dwarf herb	small; 2.0-2.5 m	rocky hillsides	0-250 m	unknown (Colima)
A. acontophylla Pfeifer	pentandrous	sprawling herbaceous perennial	small; less than 1.0 m	open sunny areas in thorn forest	below 300 m	Colima and Michoacan
A. cardiantha Pfeifer	pentandrous	procumbent perennial herb	small; 2.0 m ±	thorn forest	ca 1000 m	Colima, Guerrero, Mexico D. F.
A. foetida H. B. K.	pentandrous	procumbent perennial herb	small; less than 1.0 m	thorn forest	200-1128 m	Jalisco, Colima, Michoacan, and Guerrero
A. conversiae Pfeifer	pentandrous	procumbent perennial herb	small	pine-oak, tropical deciduous	960-1740 m	Colima, Mexico D.F.
A. pringlei Rose	pentandrous	twining perennial herb	small	moist meadows in pine-oak forest	2285 m	Nayarit, Jalisco, Morelos, and Michoacan
A. mutabilis Pfeifer	pentandrous	procumbent perennial herb	small	thorn forest	0-250 m	Colima, Michoacan, and Guerrero

Table 2. Summary of foodplant utilization by Colima Troidini.

	philenor	polydamas	eracon	laodamas	photinus	montezuma	erithalion
A. tentaculata	+	+	+	++	++		+
A. glossa			?	?			
A. odoratissima		+	?	?			
A. n. sp.							+
A. acontophylla	++	+				++	
A. cardiantha						+	
A. foetida		+	?			+	
A. conversiae		+			++	++	?
A. pringlei	++				+		
A. mutabilis							+

++ = preferred foodplant (4 or more observations)
+ = documented foodplant (1–3 observations)
? = possible foodplant (most likely available host; no observations)

in Colima, Mexico. *Aristolochia tentaculata* is an important foodplant to nearly all the species studied. K. Brown (personal communication) suggests that the relative toxicity of different species of *Aristolochia* varies, and that the first choice of foodplant would be the least toxic species available. Where troidines occur in sympatry, there may be competition for such a foodplant. In the absence of specific biochemical data on plant secondary compounds, *A. tentaculata* is suspected to represent such a species in Colima.

From this study *Battus eracon* and *B. laodamas procas* appear to be monophagous, although this may not be the case. It is possible that both species utilize all three of the large hexandrous *Aristolochia* species available. *B. polydamas* is the most polyphagous troidine; it successfully utilizes five species of *Aristolochia* in Colima.

There is no unequivocal evidence from the data or observations that Colima troidines are partitioning hosts to avoid interspecific competition, but this is implied by regional shifts in foodplant choice. Where, for example, several troidines are sympatric, host utilization seems to differ from allopatric situations. Partitioning by *Battus* and *Parides* between hexandrous and pentandrous species of *Aristolochia* in Colima is also suggested. Pentandrous species are small, usually only 1–2 m in height; hexandrous species are typically much larger (table 1). *Parides* species lay their eggs singly (Brown, Damman, and Feeny 1981); females usually search at ground level. *Parides* thus are able to exploit small, low-growing pentandrous species. In contrast, *Battus* species typically lay eggs in batches. Gregarious larvae soon devour small foodplants and have to search for additional host material. Survival is possible on pentandrous species only where close growing stands occur. In general, *Battus* species would seem to have greater survival and face less intraspecific larval competition on large hexandrous species, where ample foodplant is available for large numbers of actively feeding larvae. This assumption is supported by the fact that *B. eracon* and *B. laodamas* were observed to feed exclusively on the large hexandrous *A. tentaculata*. Evidence to the contrary includes the preference for pentandrous species exhibited by *B. philenor*, which is moderately polyphagous, and the inability to determine preference of *B. polydamas*.

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